

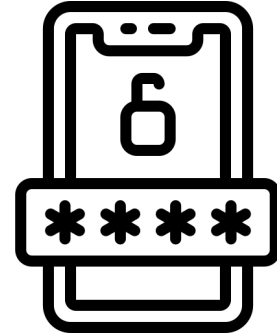
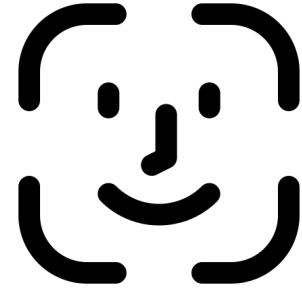
**“Say I'm in public...I don't want my nudes  
to pop up.”**

# **User Threat Models for Using Vault Applications**

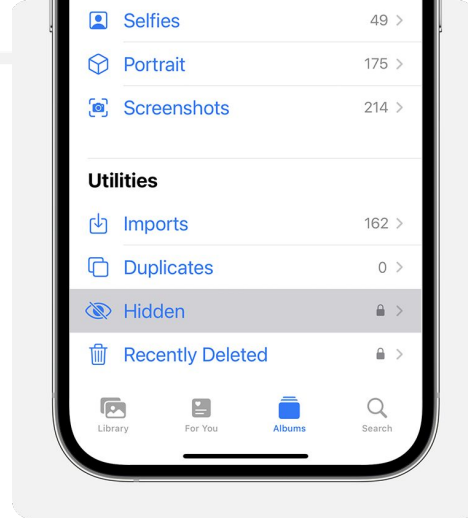
**Chris Geeng (they/them)**, Natalie Chen, Kieron Ivy Turk, Jevan Hutson,  
Damon McCoy



# What are vault apps?



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# What are vault apps?



ABC50 NOW

# Local experts warn of fake calculator app, allowing children to hide photos, videos

by: [Isabella Colello](#)

Posted: Mar 12, 2021 / 04:47 PM EST

Updated: Mar 12, 2021 / 04:49 PM EST

# How Colorado teenagers hid a massive nude sexting ring from parents and teachers



Store photos, videos, notes, files, contacts, passwords, and bookmarks privately in one place.

Works and looks just like any other calculator until you enter your secret passcode.

The image shows two white smartphones against a blue background. The left smartphone displays a dark-themed app interface with a blue header bar. Below the header, there are three menu items: 'Albums' with a camera icon, 'Notes' with a pencil icon, and 'Files' with a folder icon. To the right of the menu is a vertical strip of three small image thumbnails. The right smartphone displays a calculator interface with a dark background and white text. The number '2,684' is prominently displayed in the center. Below the number are four calculator function buttons: '+/-', '%', '÷', and '×'. The status bars at the top of both phones show signal strength, carrier name, time, and battery level.

# Vault app usage

- Intimate media (Geeng et al. 2020)
- Social media apps, photos and videos, menstrual period trackers, banking apps, and intimate media (Sambasivan & Checkley et al. 2018)

# Researchers find that tech-savvy adversaries can easily access vault apps

Research gap: what are the adversaries that users are actually using vault apps for?



# Researchers find that tech-savvy adversaries can easily access vault apps

## Vault app as used by adversary:

- Defense to be broken, e.g., by police to get evidence on criminals (Dorai et al. 2020)

## Vault app used as user defense:

- Adversaries with **limited technical capabilities** can discover a vault app and its files (Ruffin et al. 2022)

# Research questions:

1. What are “everyday” user threat models in the U.S.?
2. Do vault apps meet U.S. user needs?

# Methods



# Qualitative research study:

- Semi structured interviews (N=18)
- Adults who use vault apps in the U.S.
- Inductive coding process
- What concerns prompted participants to start using the app
- Features they like or want
- What do they store on the vault app

# Results



# General Threat Model

**Assets:** sensitive files

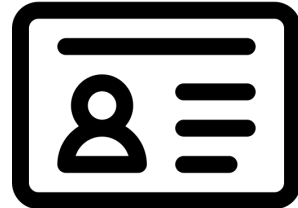
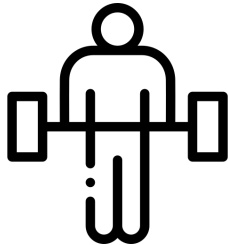
**Threats:** unintended audiences

**Harms:** exposure could bring up feelings of embarrassment or shame, loss of dignity, questions or lectures from family, or old memories in oneself

# Assets stored on vault apps:



1. Sexual imagery of others or oneself
2. Non-sexual body photos
3. Photos of partying or drinking
4. Photos of old partners
5. Sensitive documents, e.g., IDs and password lists
6. Medical photos or conversations



# Particularly vulnerable assets

- Screenshots and files related to stigmatized medical diagnosis
- NSFW photos of marginalized genders



# Threats users use vault apps towards



Shoulder Surfing

# Shoulder Surfing

**P2:**

“ When I'm in public, I'd rather not have some of those [intimate] images that are far back to be shown as I'm scrolling, 'cause I take a lot of public transit. I'm usually around a lot of people. So I wanna make sure that those images aren't accidentally shown when I'm in some of those more social situations. ”

# Threats users use vault apps towards



Shoulder Surfing



Accidental Exposure  
While Sharing Device

# Threats users use vault apps towards



Shoulder Surfing



Accidental Exposure  
While Sharing Device



Parental Device  
Snooping

# Parental Snooping

**P17**  
:

“ Even though I’m [over 18] now, I have regular checkups on my mobile phone.... Since my parents do regular checkups, they know my password to open the phone, but for the secure folder, that I have hidden the password from them. ”

# Adversaries: mostly accidental

- Friends
- Family
- Work
- General public



Shoulder Surfing



Accidental Exposure  
While Sharing Device

# Other Results

- Affordance trade-offs
- Learning about vault apps
- Behavior prior to using a vault app

# Affordance S Trade-Offs

- Biometrics vs. PIN
- Automatic cloud backup vs. no backup
- Vault app being a feature in an existing feature in an app vs. a separate app



# Learning about vault apps



Found accidentally  
looking through phone



Search Online



Friends and Family

# Takeaways

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**Misconception:  
vault app usage  
is nefarious.**



# Vault apps protect from context collapse



(but not from tech-savvy adversaries)

# **Vault apps are for (mostly) accidental adversaries; not targeted hackers, corporations, government.**



# Design Recommendations

1. Authentication choices
2. Optional extra friction before opening files
3. Better communication of where files are stored/backed-up and how to change that
4. Non-paywalled features



# Summary

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- People, including from vulnerable communities, use vault apps for many non-malicious reasons
- To protect from context collapse/accidental exposure, not targeted adversaries
- Main draw is authentication; customizable authentication would allow users to choose their preferred usability/security trade-off

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# How apps frame their

## Hide photos on your iPhone, iPad, or Mac with the Hidden album

With Photos, you can control which photos and videos are visible and what's hidden.





# Future Work

- Larger-scale survey on vault app usage
- Evaluation of whether how apps present their security/privacy features maps to actual practice
- Vault app usage with specific vulnerable content and marginalized communities and whether it meets their needs

# Apps Mentioned

- Hidden albums within photo gallery apps: iPhone Photos, Google Photos. The hidden albums are accessed within each app by traversing the app's albums/library. These hide photos and videos.
- Snapchat's My Eyes Only album. Photos and videos in this album are stored on Snapchat's servers. If the user forgets the password, the photos are lost forever; there is no recovery process.
- Samsung's recommended app Secure Folder. It can lock photos and videos, files, and other apps.
- Third-party vault apps like Secret Photo

ID	Gender	Sexual Orientation	Age in Years	Race
1	man	straight	18-24	Latino
2	non-binary / third gender	gay	25-34	Latino
3	woman	bisexual	18-24	Asian
4	man	gay	25-34	White
5	man	gay	25-34	Asian
6	man	gay	25-34	Black
7	non-binary / third gender woman,	N/A	18-24	Asian
8	non-binary / third gender	queer	25-34	White
9	woman	bisexual	18-24	White
10	man	straight	18-24	White
11	man	N/A	18-24	Asian
12	woman	straight	18-24	Black
13	woman	N/A	18-24	Asian
14	man	straight	25-34	Asian
15	man	straight	18-24	Asian
16	man	straight	25-34	Asian
17	man	straight	18-24	Asian
18	non-binary / third gender	queer	25-34	White

Table 1: Demographic information of interview participants ( $N = 18$ ). N/A means the participant did not specify an answer.

Education	#	Relationship Status	#
bachelor's degree	7	single	7
graduate or professional degree	7	dating	5
some college, but no degree	4	partnered	2
		N/A	3
Household Income	#	Relationship Style	#
\$150,000 or more	1	monogamous	16
100,000–149,999	3	open and monogamous	1
75,000–99,000	1	N/A	1
50,000–74,999	2		
25,000–49,999	3		
less than \$25,000	6		
N/A	2		

Table 2: Aggregate demographic information of participants. N/A means the participant did not specify an answer.

# Positively Mentioned Affordances

Customizable password different from phone authentication

Biometric authentication (fingerprint or FaceID)

Different folders opened by different customizable password

Disguising app icon (e.g., Calculator)

Hidden album is within an already used app (e.g., iOS Photos, Snapchat)

Vault app is separate from an already used app

Locked photos are hidden from Memories (e.g., Snapchat)

Built-in sharing functionality to other social media or messaging apps

Folder Creation

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### **Positively-Mentioned Affordances**

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<b>List of Apps</b>	<b>PIN?</b>	<b>Biometrics?</b>	<b>Swipe Pattern?</b>	<b>Selective Access (different "accounts")</b>	<b>Steps to Access</b>
Snapchat My Eyes Only	4 digits	N	N	N	2 swipes
iOS Photos Hidden Album	Screen Lock		N	N	2 clicks
Google Photos (hidden album)	Screen Lock			N	3 clicks
Dropbox (locked file)	Password (Paid version only)	N	N	Y - select who has access	2 clicks
Secret Photo Album	Y	N	Y	N	Open + unlock
Secure Folder (Android Files)	4 digits	N	Y	N	2 clicks + unlock
Photo Vault (KeepSafe)	4 digits	Fingerprint	Y	decoy vault (2nd PIN) No seperate accounts	Open + unlock
Vault	15 digits	Fingerprint	Y	decoy vaults (PAID ONLY)	Open + unlock
Adobe Acrobat (locked file)	Password (Paid version only)	N	N	N	Open + unlock each file
App Lock	N	N	Y	Y - "Profiles"	Open + unlock
iOS Notes (locked file)	Y	Y screen lock	N	N	Open + unlock
OneNote	Password	N	N	N	Open + unlock

# Apps Mentioned

- Hidden albums within photo gallery apps
- Snapchat's My Eyes Only album
- Samsung's recommended app Secure Folder
- Third-party vault apps
- And locked files within existing note apps